Section 23
Tunnel and Shaft Construction

23.1 Scope

This section sets forth requirements for tunnel and shaft construction, which includes underground tunnels, shafts, caverns, chambers, passageways, and cut-and-cover tunneling. Where this section does not provide specific definitions or instructions, it adopts, by reference, the current editions of the Federal Occupational Safety and Health Administration (OSHA) regulations.

23.2 General Requirements

23.2.1 Planning

All Reclamation employees must conduct tunnel and shaft construction following the requirements of this section and OSHA 29 CFR 1926.800, *Underground Construction*.

23.2.2 Non-construction Activities

Reclamation employees conducting non-construction work, such as inspections and general maintenance in existing tunnels and shafts, shall follow the requirements of other applicable Reclamation Safety Health Standard (RSHS) sections to address the hazards of the non-construction activities.

23.2.3 Construction Activities

Reclamation employees conducting construction work in new and existing tunnels and shafts shall follow the requirements of this section and other applicable RSHS sections. Construction work in existing tunnels and shafts includes, but is not limited to, alterations, re-coating a penstock, re-building tunnel or shaft walls, and/or installing new equipment.

23.2.4 Contract Activities

The contracting officer shall ensure contractors comply with the safety requirements outlined in the safety specifications detailed in the contract.

23.3 Responsibilities

23.3.1 Project Manager

23.3.1.1 Shall ensure the tunnel and shaft construction project is designed and operated to meet the requirements of this section.

23.3.1.2 Shall provide rescue teams for tunnel and shaft construction projects.

23.3.2 First-Line Supervisors

23.3.2.1 Shall provide employees working on tunnel and shaft construction jobsites with the training outlined in paragraph 23.4, *Training Requirements*, of this RSHS.

23.3.2.2 Shall ensure the designated person required by paragraph 23.8.4.4, *Designated Persons*, is on duty outside the tunnel or shaft when employees are inside the tunnel or shaft.

23.3.2.3 Shall brief the oncoming shift supervisor of hazardous conditions as required by paragraph 23.6, *Pre-job Briefing and Planning Requirements*.

23.3.2.4 Shall ensure all communications systems are tested and in working condition.

23.4 Training Requirements

23.4.1 Initial

Employees engaged in tunnel and shaft construction activities shall be trained on, at a minimum, the following subjects:

- recognition and avoidance of hazards associated with underground construction activities,
- confined spaces,
- air monitoring,
- ventilation,
- electrical safety,
- illumination,
- communications,
- flood control,
- unstable ground,
- cave-ins,
- rockslides,
- mechanical equipment,
- hoisting,
- load handling,
- personal protective equipment (PPE),
- fall protection,
- hazardous materials,
- explosives,
- fire prevention and protection,
- emergency procedures,
- evacuation plans, and

- check-in/check-out systems.

23.4.2 Records

Reclamation shall keep training records in the Department of the Interior's approved repository and manage records in accordance with the Information Management Handbook as referenced in Reclamation Manual Directive and Standard, Information Management (RCD 05-01).

23.5 Hazard Identification, Assessment, and Safety Measures

The project manager, supervisors, and employees shall develop a job hazard analysis (JHA) for all tunnel and shaft construction activities. The JHA shall meet the requirements of RSHS Section 4, *Work Safety Planning*.

23.6 Pre-job Briefing and Planning Requirements

Outgoing shift supervisors shall inform oncoming shift supervisors of hazardous occurrences and conditions that affected or might affect employee safety. Oncoming supervisors shall inform oncoming shifts of any hazardous occurrences or conditions that have affected or might affect employee safety, including but not limited to liberation of gas, equipment failures, earth or rock slides, cave-ins, flooding, fires, or explosions.

23.7 Personal Protective Equipment

The JHA shall identify PPE appropriate for tunnel and shaft construction activities. PPE shall meet the requirements of RSHS Section 8, *Personal Protective Equipment*.

23.8 Safe Practices

23.8.1 Access and Egress

23.8.1.1 General. The project manager shall provide and maintain safe means of access and egress, meeting the requirements of OSHA 29 CFR 1926.800, to all workstations.

23.8.1.2 Control Openings. The project manager shall control access to all tunnel and shaft openings to prevent unauthorized entry to tunnel and shaft construction areas.

23.8.2 Check-in/Check-out. The project manager shall establish a check-in/check-out procedure that will ensure above ground personnel can determine an accurate number of persons in the tunnel or shaft.

23.8.3 Communications

23.8.3.1 General. All means of communication must meet the requirements of OSHA 29 CFR 1926.800.

23.8.3.2 Power Supply. Powered communications systems must operate on an independent power supply and be charged at all times.

23.8.3.3 Working Alone. The project manager shall provide an employee working alone, in a hazardous location, out of range of unassisted voice communication, and not under direct observation, with an effective means of obtaining emergency assistance.

23.8.3.4 Testing. Supervisors and employees shall test communication systems each shift prior to tunnel and shaft entry and as often as necessary at later times to ensure the communication systems are in working order.

23.8.4 Emergency Provisions

23.8.4.1 General. Emergency provisions must meet the requirements of OSHA 29 CFR 1926.800.

23.8.4.2 Egress. The project manager shall, when a shaft is used as a means of egress, ensure an emergency power-assisted hoisting system is installed, tested, and ready for use during an emergency, unless the regular hoisting means can continue to function during an electric power failure at the jobsite.

23.8.4.3 Self-Rescuer Respirators. All employees and visitors that might be trapped by harmful air environments in tunnels and shafts must use closed-circuit escape (self-rescuer) respirators approved by the National Institute for Occupational Safety and Health under 42 CFR part 84.

23.8.4.4 Designated Person. The designated employee, stationed outside the tunnel or shaft by the first-line supervisor, is responsible for securing immediate aid and keeping an accurate count of employees in the tunnel or shaft in the event of an emergency.

23.8.4.5 Lighting. Employees shall use a portable emergency lighting source in a tunnel or shaft, unless natural light or an emergency lighting system provides adequate illumination for escape.

23.8.5 Rescue Teams

23.8.5.1 General. The project manager shall ensure rescue teams that meet the requirements of OSHA 29 CFR 1926.800 are provided.

23.8.5.2 25 or More Employees. The project manager shall ensure at least 2, 5-person rescue teams are provided when 25 or more employees are working in tunnels or shafts. One rescue team shall be on the jobsite or within half an hour travel time from the tunnel or shaft entrance. The second rescue team shall be within a 2-hour travel time from the tunnel or shaft entrance.

23.8.5.3 Fewer than 25 employees. The project manager shall ensure at least 1, 5-person rescue team is provided when fewer than 25 employees are working in tunnels or shafts. The rescue team shall be on the jobsite or within half an hour travel time from the tunnel or shaft entrance.

23.8.5.4 Qualified Rescue Team. The rescue team members must be qualified in rescue procedures for tunnel and shaft construction projects and must be familiar with conditions at the jobsite.

23.8.6 Hazardous Classifications

23.8.6.1 General. The project manager shall, as necessary, assign the tunnel and shaft construction project with air environment hazardous classifications meeting the requirements of OSHA 29 CFR 1926.800.

23.8.6.2 Potentially Gassy Operation. The project manager shall classify the tunnel or shaft as a potentially gassy operation if air monitoring discloses 10 percent or more of the lower explosive limit for methane or other flammable gases for more than a 24-hour period, or geological information indicates 10 percent or more of the lower explosive limit for methane or other flammable gases is likely.

23.8.6.3 Gassy Operation. The project manager shall classify the tunnel or shaft as a gassy operation if air monitoring discloses 10 percent or more of the lower explosive limit for methane or other flammable gases for 3 consecutive days, there has been

an ignition of methane or other flammable gases, or the tunnel or shaft is exposed to air flow from a connected tunnel or shaft classified as a gassy operation.

23.8.6.4 Equipment. The project manager and supervisor shall ensure equipment used in gassy operations meets the requirements of OSHA 29 CFR 1926.800 and 30 CFR Part 36, *Approval Requirements for Permissible Mobile Diesel-Powered Transportation Equipment*.

23.8.6.5 Signs. The project manager shall post signs at each entrance to tunnels or shafts classified as a gassy operation notifying all entrants of the gassy classification.

23.8.6.6 Ignition Sources. Smoking and ignition sources, such as matches and lighters, are prohibited in tunnels and shafts classified as a gassy operation.

23.8.6.7 Hot Work. The supervisor shall provide a fire watch when hot work is conducted in tunnels and shafts classified as a gassy operation.

23.8.7 Air Quality and Monitoring

23.8.7.1 General. The project manager and supervisor shall ensure air quality and air monitoring in tunnel and shaft construction projects meet the requirements of OSHA 29 CFR 1926.55, *Gases, Vapors, Fumes, Dusts, and Mists*, and OSHA 29 CFR 1926.800.

23.8.7.2 Air Monitoring. A trained employee must perform air monitoring that meets the requirements of OSHA 29 CFR 1926.800 in tunnel and shaft construction projects.

23.8.8 Ventilation

23.8.8.1 General. Ventilation must meet the requirements of OSHA 29 CFR 1926.800 in tunnel and shaft construction projects.

23.8.8.2 Fresh Air. All tunnel or shaft work areas must have a sufficient fresh air supply to prevent dangerous or harmful accumulation of dust, fumes, mists, vapors, or gases.

23.8.8.3 Reversible Flow. The project manager shall ensure the mechanical air flow direction is reversible.

23.8.9 Illumination

Illumination must meet the requirements of OSHA 29 CFR 1926.56, *Illumination*, Table D-3, *Minimum Illumination Intensities in Foot-Candles*, and OSHA 29 CFR 1926.800 in tunnel and shaft construction projects.

23.8.10 Fire Prevention and Control

23.8.10.1 General. Fire prevention and control must meet the requirements of OSHA 29 CFR 1926 Subpart F, *Fire Protection and Prevention*, and OSHA 29 CFR 1926.800 in tunnel and shaft construction projects.

23.8.10.2 Open Flames. The supervisor shall prohibit open flames in all tunnel and shaft construction operations except as permitted for welding, cutting, and other hot work operations.

23.8.10.3 Portable Fire Extinguishers.
The project manager and supervisor shall provide portable fire extinguishers throughout all tunnel and shaft construction work areas following the requirements of OSHA 29 CFR 1926.150, *Fire Protection*.

23.8.10.4 Above Ground Storage. The project manager and supervisor shall locate above-ground storage of flammable or combustible materials at least 100 feet away from any access opening to any underground operation.

23.8.10.5 Diesel Fuel. The supervisor shall allow the storage of no more than a 24-hour supply of diesel fuel in tunnel and shaft construction work areas.

23.8.10.6 Gasoline. The supervisor shall not allow gasoline in tunnel and shaft construction project work areas.

23.8.10.7 Hydraulic Fluids. Hydraulically actuated machinery and equipment used in tunnel and shaft construction projects must use fire-resistant hydraulic fluids or utilize a fire suppression system.

23.8.11 Welding, Cutting, and Other Hot Work

23.8.11.1 General. Welding, cutting, and other hot work performed in tunnel and shaft construction projects must meet the requirements of OSHA 29 CFR 1926 Subpart J, *Welding and Cutting*, and OSHA 29 CFR 1926.800.

23.8.11.2 Welding Gases. The supervisor shall allow no more than the amount of fuel gas and oxygen cylinders needed to perform welding, cutting, and other hot work for a 24-hour period in tunnel and shaft construction work areas.

23.8.12 Ground Support

23.8.12.1 General. The project manager and supervisor shall ensure the area and ground around and in tunnel and shaft construction projects are protected, stabilized, scaled, and supported to meet the requirements of OSHA 29 CFR 1926.800.

23.8.12.2 Portal Areas. The project manager shall ensure portal openings and access areas are protected by shoring, fencing, head walls, shotcrete, scaling, securing loose materials, or other equivalent protection methods for the safe access of employees and equipment.

23.8.12.3 Inspections. A trained employee must perform inspections in tunnel and shaft construction work areas at the start of each shift and as often as necessary to determine ground stability and safe passage.

23.8.13 Blasting

Blasting operations performed in tunnel and shaft construction projects must meet the requirements of OSHA 29 CFR 1926 Subpart U, *Blasting and the Use of Explosives*, and OSHA 29 CFR 1926.800.

23.8.14 Drilling

23.8.14.1 General. Drilling operations performed in tunnel and shaft construction projects must meet the requirements of OSHA 29 CFR 1926.800 and RSHS Section 27, *Reclamation Drilling Standards*.

23.8.14.2 Inspections. A trained employee must perform inspections of drilling equipment prior to each use and the drilling area prior to start of work to identify deficiencies and hazards.

23.8.15 Haulage

23.8.15.1 General. Haulage operations performed in tunnel and shaft construction projects must meet the requirements of OSHA 29 CFR 1926.800 and RSHS Section 20, *Mobile Mechanized Equipment*.

23.8.15.2 Bumper Blocks. The project manager shall provide bumper blocks or equivalent stopping devices at all track dead ends.

23.8.15.3 Equipment Hauling. The supervisor shall ensure hauled equipment is loaded and secured to prevent sliding and dislodgement.

23.8.16 Electrical Safety

Electrical systems and electrical safety in tunnel and shaft construction projects must meet the requirements of OSHA 29 CFR 1926 Subpart K, *Electrical*, and OSHA 29 CFR 1926.800.

23.8.17 Cranes and Hoists

All crane and hoisting operations in tunnel and shaft construction projects must meet the requirements of OSHA 29 CFR 1926.552, *Material Hoists, Personnel Hoists, And Elevators*, OSHA 29 CFR 1926 Subpart CC, *Cranes and Derricks in Construction*, OSHA 29 CFR 1926.800, RSHS Section 19A, *Permanently Installed (Fixed) Cranes*, and RSHS Section 19B, *Mobile Cranes*.

23.9 Definitions in Appendix K and References in Appendix L